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09/29/00  
JCS17 U.S. PTO09/29/00  
JCS25 U.S. PTO**UTILITY PATENT APPLICATION TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 042390.P9731Total Pages 2First Named Inventor or Application Identifier Robert Dunstan, et al.Express Mail Label No. EL627464468US

**ADDRESS TO:** **Assistant Commissioner for Patents**  
**Box Patent Application**  
**Washington, D. C. 20231**

**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents.

1.  Fee Transmittal Form  
(Submit an original, and a duplicate for fee processing)
2.  Specification (Total Pages 25)  
(preferred arrangement set forth below)
  - Descriptive Title of the Invention
  - Cross References to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to Microfiche Appendix
  - Background of the Invention
  - Brief Summary of the Invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claims
  - Abstract of the Disclosure
3.  Drawings(s) (35 USC 113) (Total Sheets 6)
4.  Oath or Declaration (Total Pages 5)
  - a.  Unexecuted (Original or Copy)
  - b.  Copy from a Prior Application (37 CFR 1.63(d))  
(for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**
  - i.  DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5.  Incorporation By Reference (useable if Box 4b is checked)  
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6.  Microfiche Computer Program (Appendix)

7.  Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)  
a.  Computer Readable Copy  
b.  Paper Copy (identical to computer copy)  
c.  Statement verifying identity of above copies

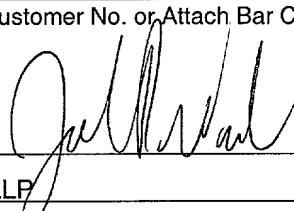
#### ACCOMPANYING APPLICATION PARTS

8.  Assignment Papers (cover sheet & documents(s))  
9.  a. 37 CFR 3.73(b) Statement (where there is an assignee)  
 b. Power of Attorney  
10.  English Translation Document (if applicable)  
11.  a. Information Disclosure Statement (IDS)/PTO-1449  
 b. Copies of IDS Citations  
12.  Preliminary Amendment  
13.  Return Receipt Postcard (MPEP 503) (Should be specifically itemized)  
14.  a. Small Entity Statement(s)  
 b. Statement filed in prior application, Status still proper and desired  
15.  Certified Copy of Priority Document(s) (if foreign priority is claimed)  
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17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

Continuation  Divisional  Continuation-in-part (CIP)  
of prior application No: \_\_\_\_\_

18. **Correspondence Address**

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**FEET TRANSMITTAL FOR FY 2000****TOTAL AMOUNT OF PAYMENT (\$)** \$978.00**Complete if Known:**

Application No. Unassigned  
 Filing Date Herewith  
 First Named Inventor Robert Dunstan, et al.  
 Group Art Unit Unassigned  
 Examiner Name Unassigned  
 Attorney Docket No. 042390.P9731

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**FEE CALCULATION****1. BASIC FILING FEE**

Large Entity	Small Entity				
Fee	Fee	Fee	Fee		
Code	(\$)	Code	(\$)		
101	690	201	345	Fee Description	
106	310	206	155	Utility application filing fee	
107	480	207	240	Design application filing fee	
108	690	208	345	Plant filing fee	
114	150	214	75	Reissue filing fee	
				Provisional application filing fee	

SUBTOTAL (1) \$ 690.00**2. EXTRA CLAIM FEES**

	Extra Claims	Fee from below	Fee Paid
Total Claims	23	- 20** = 3	X 18 = 54.00
Independent Claims	6	- 3** = 3	X 78 = 234.00
Multiple Dependent			=

\*\*Or number previously paid, if greater; For Reissues, see below.

Large Entity	Small Entity				
Fee	Fee	Fee	Fee		
Code	(\$)	Code	(\$)		
103	18	203	9	Fee Description	
102	78	202	39	Claims in excess of 20	
104	260	204	130	Independent claims in excess of 3	
109	78	209	39	Multiple dependent claim, if not paid	
110	18	210	9	**Reissue independent claims over original patent	
				**Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) \$ 288.00

**FEE CALCULATION (continued)**

**3. ADDITIONAL FEES**

<u>Large Entity</u>	<u>Small Entity</u>	<u>Fee Description</u>	<u>Fee Paid</u>
Fee Code	Fee (\$)	Fee Code (\$)	
105	130	205	65
127	50	227	25
139	130	139	130
147	2,520	147	2,520
112	920*	112	920*
113	1,840*	113	1,840*
115	110	215	55
116	380	216	190
117	870	217	435
118	1,360	218	680
128	1,850	228	925
119	300	219	150
120	300	220	150
121	260	221	130
138	1,510	138	1,510
140	110	240	55
141	1,210	241	605
142	1,210	242	605
143	430	243	215
144	580	244	290
122	130	122	130
123	50	123	50
126	240	126	240
581	40	581	40
146	690	246	345
149	690	249	345
Other fee (specify)			
Other fee (specify)			

**SUBTOTAL (3) \$ 00.00**

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**SUBMITTED BY:**

Typed or Printed Name: John P. Ward

Signature John P. Ward Date September 29, 2000

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Michelle Begay

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Serial/Patent No.:	***	Filing/Issue Date:	***
Client:	<u>Intel Corporation</u>		
Title:	<u>METHOD AND APPARATUS FOR FACILITATING POWER STATE CONTROL AND AWARENESS OF AN AUTONOMOUS SUBSYSTEM IN A COMPUTER</u>		
BSTZ File No.:	<u>042390.P9731</u>		
Atty/Secty Initials:	<u>JPW/AEH/mb</u>		
Date Mailed:	<u>September 29, 2000</u>		
Docket Due Date: ***			
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<input type="checkbox"/> Appeal Brief (____ pgs.) (in triplicate) <input type="checkbox"/> Month(s) Extension of Time <input type="checkbox"/> Amt: <u>\$978.00</u>			
<input checked="" type="checkbox"/> Application - Utility <u>25</u> pgs., with cover and abstract <input type="checkbox"/> Information Disclosure Statement & PTO-140 (____ pgs.) <input type="checkbox"/> Check No. _____			
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## UNITED STATES PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR FACILITATING POWER STATE CONTROL  
AND AWARENESS OF AN AUTONOMOUS SUBSYSTEM IN A COMPUTER  
BASED SYSTEM

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METHOD AND APPARATUS FOR FACILITATING POWER STATE CONTROL  
AND AWARENESS OF AN AUTONOMOUS SUBSYSTEM IN A COMPUTER  
BASED SYSTEM

5

FIELD OF THE INVENTION

The present invention pertains to the field of computers. More particularly, the present invention relates to facilitating power state control and awareness of an autonomous subsystem in a computer based system.

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BACKGROUND OF THE INVENTION

Computer based systems are becoming more mobile. This mobility often places an emphasis on usability. Usability is often extended by the ability to operate the equipment for longer periods of time. This time period is often related to the power 15 consumption of the equipment, particularly in battery operated equipment. Thus, high power consumption may pose problems.

Numerous approaches to reducing power consumption have been tried. Powering off equipment when not in active use is one approach. Other approaches involve putting equipment in various lower power states, such as, idle mode, sleep mode, hibernation 20 mode, etc. Such approaches may involve turning off portions of circuits or components, powering down subsystems and/or the main system, lowering supply voltages, altering

clocking mechanisms, transferring data from, for example, random access memory (RAM) to disk storage, etc.

The powering up and down of subsystems without some form of communication between the subsystems or coordination may result in power cycling when not needed.

- 5 This uncoordinated powering up and down may result in unneeded and unnecessary power consumption and present a problem for battery operated equipment.

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## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

- 5      Figure 1 illustrates a networked computer environment;
- Figure 2 is a block diagram of a computer system;
- Figures 3, and 4 are block diagrams illustrating various embodiments of the present invention;
- Figures 5, and 6 are flow diagrams illustrating various embodiments of the
- 10     invention; and
- Figure 7 is a block diagram illustrating an embodiment of the present invention.

## DETAILED DESCRIPTION

A method and apparatus for facilitating power state control and awareness of an autonomous subsystem in a computer based system are described. For purposes of discussing the invention, it is to be understood that various terms are used by those 5 knowledgeable in the art to describe energy control and awareness. Reference is made to subsystems, but it is understood that such references are with respect to an energy control or awareness device. That is, from the point of view of a energy controller, for example, a main processor, a hard disk drive, and a communications subsystem all are considered subsystems. They are all subsystems with respect to the energy control system. An 10 autonomous subsystem is understood to be a subsystem that does not require the use of a computer operating system to coordinate and/or control all aspects of the subsystem operation. Thus, an autonomous subsystem with respect to energy control, does not need an operating system to effect the energy control mechanisms described in the present invention. That is, an autonomous subsystem for energy control purposes exists 15 independently, and without outside control of an operating system may respond and/or react on its own.

The terms energy control or energy controller and power control or power controller are to be understood to refer to the same controlling mechanism. While energy is understood to be related to the integral over time of power, for purposes of the present 20 invention and the discussion, they are to be understood as interrelated and interchangeable as relating to controlling a device such that power or total energy is controlled. Likewise, the power state or energy state of a system or device may have a

- continuum of ranges. For example, power states may be, but are not limited to, full on, full wakeup, limited wakeup, light sleep, deep sleep, hibernation, full off, etc.
- Additionally, the power state may be achieved by a variety of mechanisms, such as, but not limited to, reduced current, reduced voltage, reduced frequency of operation,
- 5      powering off sections of circuits or subsystems, etc. Also, it is to be understood that an energy controller or power controller may be implemented in a variety of ways. For example, an energy controller may, but is not limited to, implementation by use of an embedded controller. That is, the embedded controller may control various mechanisms as noted above to effect the energy control.
- 10      A machine-readable medium is understood to include any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computer). For example, a machine-readable medium includes read only memory (ROM); random access memory (RAM); magnetic disk storage media; optical storage media; flash memory devices; electrical, optical, acoustical or other form of propagated signals (e.g., carrier waves, infrared signals, 15      digital signals, etc.); etc.
- Figure 1 illustrates a network environment in which the techniques described may be applied. As shown, several computer systems in the form of M servers 104-1 through 104-M and N clients 108-1 through 108-N are connected to each other via a network, which may be, for example, the Internet. Note that alternatively the network 102 might be or include one or 20      more of: a Local Area Network (LAN), Wide Area Network (WAN), satellite link, fiber network, cable network, or a combination of these and/or others. The method and apparatus

described herein may be applied to essentially any type of communicating means or device whether local or remote, such as a LAN, a WAN, a system bus, a disk drive, storage, etc.

- Figure 2 illustrates a conventional personal computer in block diagram form, which may be representative of any of the clients and servers shown in Figure 1. The block diagram
- 5 is a high level conceptual representation and may be implemented in a variety of ways and by various architectures. Bus system 202 interconnects a Central Processing Unit (CPU) 204, Read Only Memory (ROM) 206, Random Access Memory (RAM) 208, storage 210, display 220, audio, 222, keyboard 224, pointer 226, miscellaneous input/output (I/O) devices 228, and communications 230. The bus system 202 may be for example, one or more of such buses as a
- 10 system bus, Peripheral Component Interconnect (PCI), Advanced Graphics Port (AGP), Small Computer System Interface (SCSI), Institute of Electrical and Electronics Engineers (IEEE) standard number 1394 (FireWire), etc. The CPU 204 may be a single, multiple, or even a distributed computing resource. The ROM 206 may be any type of non-volatile memory, which may be programmable such as, mask programmable, flash, etc. RAM 208 may be, for
- 15 example, static, dynamic, synchronous, asynchronous, or any combination. Storage 210, may be Compact Disc (CD), Digital Versatile Disk (DVD), hard disks, optical disks, tape, flash, memory sticks, video recorders, etc. Display 220 might be, for example, a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), a projection system, Television (TV), etc. Audio 222 may be a monophonic, stereo, three dimensional sound card, etc. The keyboard 224 may be a
- 20 keyboard, a musical keyboard, a keypad, a series of switches, etc. The pointer 226, may be, for example, a mouse, a touchpad, a trackball, joystick, etc. I/O devices 228, might be a voice command input device, a thumbprint input device, a smart card slot, a Personal Computer Card

(PC Card) interface, virtual reality accessories, etc., which may optionally connect via an input/output port 229 to other devices or systems. An example of a miscellaneous I/O device 228 would be a Musical Instrument Digital Interface (MIDI) card with the I/O port 229 connecting to the musical instrument(s). Communications device 230 might be, for example,

5    an Ethernet adapter for local area network (LAN) connections, a satellite connection, a settop box adapter, a Digital Subscriber Line (xDSL) adapter, a wireless modem, a conventional telephone modem, a direct telephone connection, a Hybrid-Fiber Coax (HFC) connection, cable modem, etc. The external connection port 232 may provide for any interconnection, as needed, between a remote device and the bus system 202 through the communications device 230. For

10    example, the communications device 230 might be an Ethernet adapter, which is connected via the connection port 232 to, for example, an external DSL modem. Note that depending upon the actual implementation of a computer system, the computer system may include some, all, more, or a rearrangement of components in the block diagram. For example, a thin client might consist of a wireless hand held device that lacks, for example, a traditional keyboard.

15    Thus, many variations on the system of Figure 2 are possible.

Referring back to Figure 1, clients 108-1 through 108-N are effectively connected to web sites, application service providers, search engines, and/or database resources represented by servers, such as servers 104-1 through 104-M, via the network 102. The web browser and/or other applications are generally running on the clients 108-1 through 20    108-N, while information generally resides on the servers 104-1 through 104-M. For ease of explanation, a single client 108-1 will be considered to illustrate one embodiment of

the present techniques. It will be readily apparent that such techniques can be easily applied to multiple clients.

In Figure 1, the client 108-1 may be running a power controlling program or sequence that has the capability to access the network. This capability would allow 5 power control or updates thereto from a server via the Internet and/or other network. A description of the method of updating or installation of any revised power control code and/or data is not necessary for an understanding of the present invention.

The power control functionality and information required for controlling a device, such as a subsystem, in the present invention may, but is not limited to, embodiment in 10 the CPU 204, the Storage 210, the Display 220, the Communications device 230, etc. This power control information may consist of, but is not limited to, subsystem 15 indicators, preferential modes of operation, power control states, power status messages, etc. Additionally, accesses through, for example, the Communications device 230 which might be, for example, an Ethernet adapter would allow access to a network wherein the information such as a subsystem power indicators and/or preferred modes of operation 20 information may be retrieved.

A subsystem may be, but is not limited to, one or more of the elements of Figure 2. For example, Storage 210 may have a subsystem that handles how data is to be stored and retrieved. Audio 222 may have a subsystem that handles when to, for example, 20 power down speakers. Communications device 230 may, for example, have a subsystem that needs to power up independently of the main system upon receiving a message.

Figure 3 is a high level block diagram of one embodiment of the present invention. An energy controller (EC) 302 is connected through dedicated communications links 303-1 through 303-N to respective subsystems 1 through N (304-1 through 304-N). The communications links 303-1 through 303-N may be used for, but 5 are not limited to, communicating information and/or status, power or energy control, configuration of a subsystem, etc.

Figure 4 is a high level block diagram of another embodiment of the present invention. An energy controller (EC) 402 is connected through a shared communications link 406 to subsystems 1 through N (404-1 through 404-N). The communications link 10 406 may be used for, but is not limited to, communicating information and/or status, power or energy control, configuration of a subsystem, etc. In such a shared communications link architecture, each subsystem (1 through N), may be individually addressable. In this manner the EC 402 may communicate individually with a particular subsystem. Additionally, the subsystems may be communicated to as a group. For 15 example, subsystem 1 through 10, may be communicated to while other subsystems are not communicated with. Depending upon the communication from the EC 402, it may be that all subsystems will respond. For example, the EC 402 may issue a general message for each of the subsystems to start their shut down procedure.

Figure 5 is a more detailed flow diagram of an embodiment of the present 20 invention. It is to be understood that Figure 5 represents a per subsystem flow diagram rather than an overall flow diagram for an entire system having multiple subsystems. A particular subsystem receives a communication from the EC 502. The received

communication from the EC 502 is checked to see if it is a communication for a shutdown 504. If the communication is for a shutdown the subsystem will perform the shutdown 506, optionally send an acknowledgement (ACK) 508 to the EC, and then return to waiting to receive a communication from the EC 502. If the communication is 5 not for a shutdown, then the received communication from EC 502 is checked to see if it is a communication for a status request 514. If the communication is for a status request the subsystem will report status requested 516, optionally send an acknowledgement 518 to the EC, and then return to waiting to receive a communication from the EC 502. If the communication is not for a status request, then the received communication from EC 502 10 is checked to see if it is a communication to synchronize 524. If the communication is to synchronize, the subsystem will perform the synchronization 526, optionally send an acknowledgement 528 to the EC, and then return to waiting to receive a communication from the EC 502. If the communication is not a request to synchronize, then other options 530 for processing the request may be done. After these other options 530 are 15 performed the subsystem may optionally send an acknowledgement 532 to the EC, and then return to waiting to receive a communication from the EC 502.

A communication from the energy controller to shutdown may, but is not limited to, completely shutting down, partially shutting down, operating on a different voltage, operating at a different frequency, etc. A status request may be for such information as 20 the current operating mode, power efficiency, anticipated power demand, operating options, etc. A request to synchronize may be, for example, for a memory subsystem to synchronize its data with that of a storage subsystem. For example, prior to issuing a

shutdown communication to a memory subsystem, the EC may issue a synchronize communication so that any data that may be lost in a volatile memory when shutdown is stored to a non-volatile device. Other options 530 may be, but are not limited to, communications requesting a full wakeup of the subsystem, a limited wakeup, a 5 command to resume a previous state, etc.

The optional acknowledgement (ACK) 508, 518, 528, and 532 to the EC 502 may be used for a variety of purposes. In one embodiment, the ACK may simply be an indication that the respective communication was received. In another embodiment, the ACK may indicate that the communication was received and an operation specified in the 10 communication was performed. In yet another embodiment, the lack of receipt of an ACK may cause the EC 502 to perform a hardware reset operation on the non-acknowledging subsystem. One skilled in the art will appreciate that many variations and combinations are possible.

Figure 6 is a more detailed flow diagram of an embodiment of the present 15 invention. It is to be understood that Figure 6 represents a per energy controller flow diagram. That is, a system or device may have multiple energy controllers, however for illustrative purposes Figure 6 assumes a single EC and multiple subsystems. The EC receives a communication from a subsystem 602. The received communication from the subsystem 602 is checked to see if it is a communication from a subsystem requesting a 20 full wakeup 604. If the communication is for a full wakeup of the subsystem then the EC will fully wakeup the subsystem 606, will optionally send an acknowledgement (ACK) 608 to the subsystem, and then return to waiting to receive a communication from any

subsystem 602. If the communication is not for a full wakeup, then the received communication from a subsystem 602 is checked to see if it is a communication for a limited wakeup 614. If the communication is for a limited wakeup of a subsystem then the EC will perform a limited wakeup of the subsystem 616, optionally send an acknowledgement 618 to the subsystem, and then return to waiting to receive a communication from any subsystem 602. If the communication is not for a limited wakeup 614, then the received communication from the subsystem 602 is checked to see if it is a communication to resume a previous state 624. If the communication is to resume a previous state, the previous state is retrieved 626, the previous state is restored 628 to the subsystem, an optional acknowledgement 630 may be sent to the subsystem, and then the EC returns to waiting to receive a communication from any subsystem 602. If the communication is not to resume a previous state, then other options 640 may be done. After these other options 640 are performed the EC may optionally send an acknowledgement 642 to the subsystem on whose behalf the actions were instigated, and then return to waiting to receive a communication from any subsystem 602.

A communication from the energy controller to fully wakeup or a limited wakeup of a subsystem may, but is not limited to, completely powering up the system, fully powering up parts of the subsystem, setting operating voltage levels, setting subsystem operating frequencies, etc. Resuming a previous state 624, is a request by a subsystem to be placed back to where it was previously. This request from a subsystem may be required for example after an interrupt, other processing, or communications from the EC places the subsystem in a state is not optimal for processing purposes. For example, a

memory subsystem after being shutdown may need to be restored to the state it was in prior to the shutdown in order to provide useful information. A status request may be for such information as the subsystem's controlling EC's current operating mode, power efficiency, anticipated power or battery life, operating options, etc. Other options 640 5 may be, but are not limited to, communications requesting a shutdown, a request to synchronize, etc.

Figure 7 illustrates a possible system architecture for embodiment of the present invention. An energy controller (EC) 708 is coupled to a system management bus (SMB) 721. Also coupled to the SMB 721 is a central processing unit (CPU) 702, a memory controller hub (MCH) 704, an input/output controller hub (ICH) 706, a firmware hub (FWH) 712, and a representative autonomous subsystem N 714. The ICH 706 is also coupled to a hard disk drive (HDD) 710. The EC 708 is also coupled to EC inputs 732, and voltage monitoring and control 734. Through a second bus, a low pin count (LPC) bus 707, the EC 708 is also coupled to the ICH 706, the FWH 712, and the subsystem N 15 714.

EC inputs 732, may be, but are not limited to, such inputs as: a reset button, for example on a computer; a signal from another system; a battery pack indicator; a power down button; a hibernation signal; a limited mode of operation signal; an on-off switch, etc. It is to be understood that an on-off switch in a system does not imply that in the off 20 position that the system draws no power, or that in the on position that the system is at full power. Rather a system may have a continuum of power ranges for operation and the on-off switch may serve only as an indicator of what power range the user perceives the

system should be in. For example, a user may have many programs running on a system and, for example, after finishing and saving a document, may power down the system and place the on-off switch in the off position. However, depending upon prior preferences and/or applications running the system may still be active, for example, after turning off 5 the computer the user may still want it to be able to receive wireless communications, such as incoming email.

Voltage monitoring and control 734, may be, but are not limited to, such signals as: energy reserve; a battery pack indicator; an external power pack or charger; voltage levels; a battery removed signal; a shutdown signal; a temperature indicator, etc. Voltage 10 monitoring and control 734 is to be understood to deal with the energy source for the system. For portable systems, this will most likely be a battery pack and so the signals will be relevant to energy reserves, charging, voltage, current, temperature, etc.

A possible sequence of events will serve to illustrate some of the possible features of the present invention within the architecture of Figure 7. Upon the initial powering up 15 of the system as illustrated in Figure 7, the EC 708 receives an EC input 732, from for example, a power reset circuit. EC 708 may then communicate with the voltage monitoring and control 734 to establish when power is stable. EC 708 may then issue a communication for subsystem N 714 to shutdown. Some time later, perhaps due to a wireless communication coming into subsystem N 714, subsystem N 714 may 20 communicate to EC 708 a request for a limited wakeup so that subsystem N 714 can determine if the wireless communication is intended for it and should be received and stored. EC 708 may then perform a limited wakeup of subsystem N 714. If subsystem N

714 determines that the communication is not intended for it, then subsystem N 714 may communicate to EC 708 a request to be shutdown. On the other hand, if the communication is to be received and stored, subsystem N 714 may request from EC 708 a full wakeup. After reception and storage of the information received from the wireless

5 communication within subsystem N 714, subsystem N 714 may then request a shutdown. Some time later, EC 708 may determine from the voltage monitoring and control 734 that, for example, battery life is waning and a system-wide shutdown is needed. At this point EC 708 may issue a status request to subsystem N 714 and from that determine that data in volatile memory within subsystem N 714 needs to be saved. EC 708 may then

10 communicate to subsystem N 714 to synchronize data with, for example, the HDD 710 and subsystem N 714 may acknowledge receipt of this request. The subsystem N 714, if it needs to be fully awake to effect this synchronization and is not fully awake, would request from EC 708 to be fully awoken. Upon being fully awake subsystem N 714, may then communicate to the HDD 710 through the ICH 706 when both these subsystems are

15 in a power state allowing for the transfer and storage of information. After this sequence, subsystem N 714 may acknowledge the synchronization and then the EC 708 may communicate to the subsystem N 714 to shutdown. The communications between subsystems, such as ICH 706, HDD 710, FWH 712, subsystem N 714, etc., and the EC 708 may be effected via the SMB 721. Additionally, subsystems may communicate with

20 each other via the SMB 721. Note that all the above transactions have occurred without the need for an operating system. Additionally, one skilled in the art will recognize that many other architectures, variations, and sequences are possible.

The illustrated embodiments of the present invention are to be understood as applicable to a plurality of subsystems within a single and/or distributed system or systems. For example, in a single system, there may be a subsystem handling user input, from for example, a keyboard, while at the same time another subsystem is handling, for 5 example, the transmission and reception of data via a wireless link. In the quest to conserve power these various subsystems may be in differing stages of power control, for example, they may be powering on and then powering down asynchronously and doing this possibly thousands of times per second. For example, a keyboard subsystem may power up only when a key is being activated and may power down between keystrokes. 10 Similarly, a communications subsystem may be in a limited wakeup mode for reception of data and need to be fully awake only for transmitting information.

The energy controller (EC) may be embodied in various forms as hardware, software, or a combination of these. Additionally the functionality of the EC may also adhere to industry standards. Thus, one such embodiment of the EC may, for example, be 15 an embedded controller whose operation is also compliant with the Advanced Configuration and Power Interface Specification (ACPI, Revision 2, published July 27, 2000). It is to be understood that compliance with an industry standard, which may require the use of an operating system (OS) does not in any way prevent or preclude the functionality of the present invention in an embodiment for use in or by an autonomous 20 subsystem in a system which may or may not require the use of an operating system.

Thus, a method and apparatus for facilitating power state control and awareness of an autonomous subsystem in a computer based system without involvement of a main

operating system, such as Unix®, Windows®, Linux®, etc., have been described.

Although the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention

5 as set forth in the claims. Accordingly, the specification and drawings are to be regarded  
in an illustrative rather than a restrictive sense.

CLAIMS

What is claimed is:

- 1 1. A method for controlling a power state of a subsystem, comprising:
  - 2 receiving from the subsystem a message; and
  - 3 setting the power state of the subsystem based on the message.
- 1 2. The method according to claim 1, wherein the message is selected from the group consisting of a full wakeup, a limited wakeup, a resume previous state, and a status request.
- 1 3. The method according to claim 1, wherein setting the power state of the subsystem based on the message further comprises acknowledging a received subsystem message.
- 1 4. The method according to claim 1, wherein receiving from the subsystem a message is performed without involvement of a main operating system.
- 1 5. The method according to claim 1, wherein setting the power state of the subsystem based on the message is performed without involvement of a main operating system.

- 1 6. A method for controlling a power state of a subsystem, comprising:
- 2       receiving from a controller a message; and
- 3       performing an operation based on the message.
- 1 7. The method according to claim 6, wherein the message is selected from the group
- 2 consisting of shutdown, synchronize, status request, and reset.
- 1 8. The method according to claim 6, wherein performing an operation based on the
- 2 message further comprises acknowledging a received controller message.
- 1 9. The method according to claim 6, wherein receiving from a controller a message is
- 2 performed without involvement of a main operating system.
- 1 10. The method according to claim 6, wherein performing an operation based on the
- 2 message is performed without involvement of a main operating system.
- 1 11. The method according to claim 6, wherein performing an operation based on the
- 2 message is substantially performed by the subsystem.

- 1       12. A machine-readable medium having stored thereon instructions, which when  
2       executed by a processor, causes said processor to perform the following:  
3           receive input signals;  
4           communicate with a subsystem;  
5           determine a desired power state for the subsystem based upon received input  
6       signals and communications with the subsystem; and  
7           communicate to the subsystem the desired power state.
- 1       13. The machine-readable medium according to claim 12, wherein receive input signals  
2       comprises receiving a user initiated signal, or receiving a signal indicative of remaining  
3       battery capacity, or a combination of receiving a user initiated signal and receiving a  
4       signal indicative of remaining battery capacity.
- 1       14. The machine-readable medium according to claim 12, wherein communicate with a  
2       subsystem further comprises the subsystem to acknowledge a communication.

- 1 15. A system, comprising:
  - 2 an power state controller having an input port, an output port, and a
  - 3 communications channel;
  - 4 a user input coupled to the power state controller input port;
  - 5 an energy monitor signal coupled to the power state controller input port; and
  - 6 a subsystem coupled to the power state controller output port and the power state
  - 7 controller communications channel.
- 1 16. The system of claim 15, wherein the user input is a switch to turn the system on and
- 2 off.
- 1 17. The system of claim 15, wherein the energy monitor signal is indicative of a
- 2 remaining battery capacity.
- 1 18. An apparatus for controlling subsystem power, comprising:
  - 2 means for receiving input signals;
  - 3 means for communicating with a subsystem;
  - 4 means for determining a desired power state for the subsystem based upon the
  - 5 received input signals and communications with the subsystem; and
  - 6 means for communicating to the subsystem the desired power state.

1 19. The apparatus of claim 18, wherein means for receiving input signals comprises  
2 means for receiving a user initiated signal, or means for receiving a signal indicative of  
3 remaining battery capacity, or a combination of means for receiving a user initiated signal  
4 and means for receiving a signal indicative of remaining battery capacity.

1 20. The apparatus of claim 18, wherein means for communicating with a subsystem  
2 further comprises means for the subsystem to acknowledge a communication

1 21. A computer based system, comprising:  
2 an energy source;  
3 a monitoring device coupled to the energy source and providing a signal indicative  
4 of remaining energy capacity;  
5 a power state controller coupled to the signal indicative of remaining energy  
6 capacity;  
7 a subsystem coupled to the power state controller; and  
8 a communications link coupling the power state controller to the subsystem.

1 22. The computer based system according to claim 21, wherein the communications link  
2 coupling the power state controller to the subsystem comprises a link having lower  
3 bandwidth than a main system bus in the computer based system.

- 1    23. The computer based system according to claim 21, wherein the communications link
- 2    is operable without the use of a main operating system.

### ABSTRACT OF THE DISCLOSURE

A method and apparatus for facilitating power state control and awareness of an autonomous subsystem in a computer based system without involvement of the main operating system are described.

5

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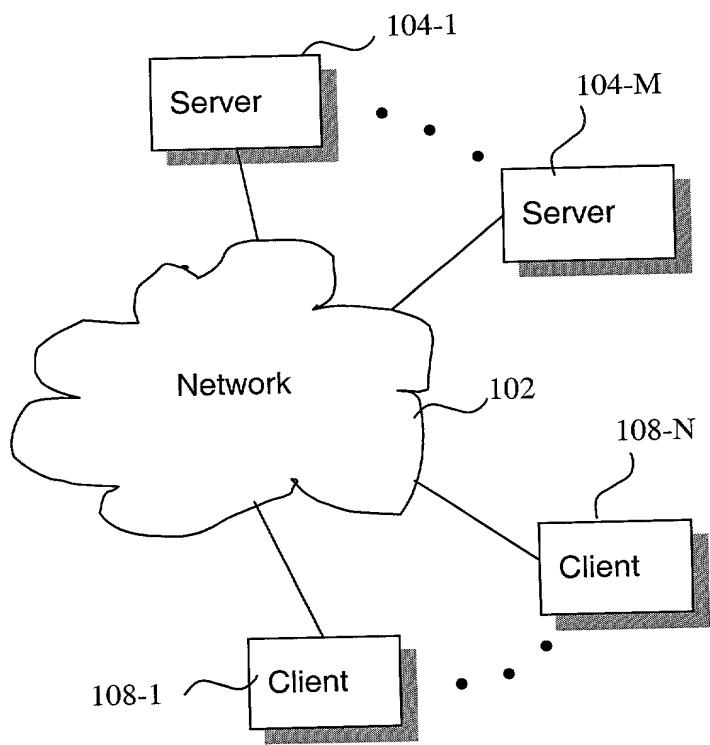


Figure 1

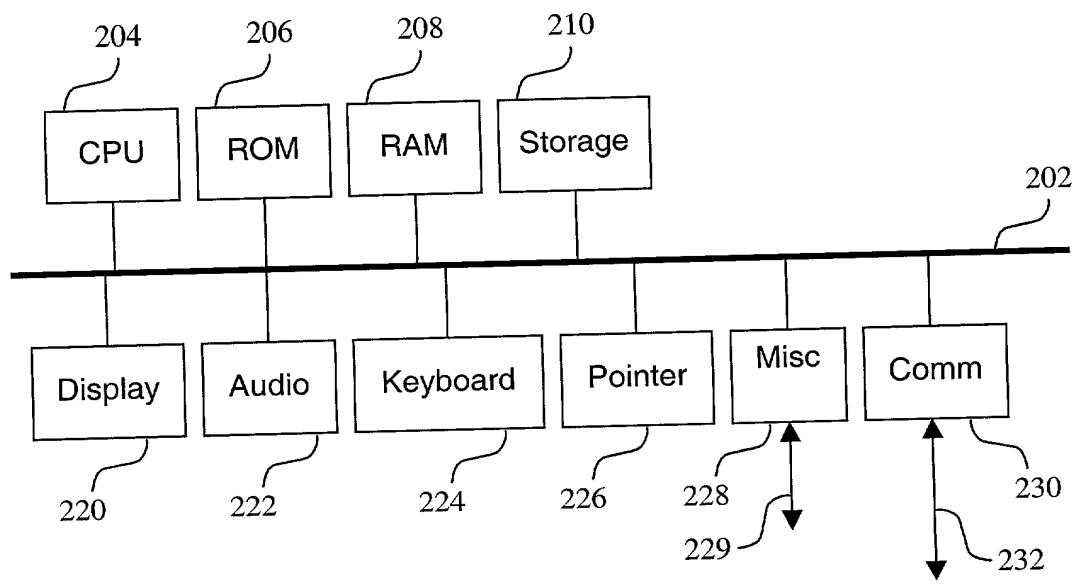


Figure 2

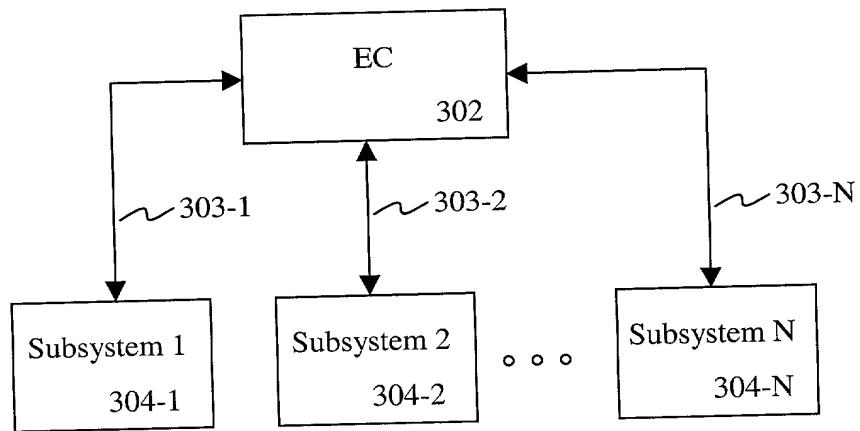


Figure 3

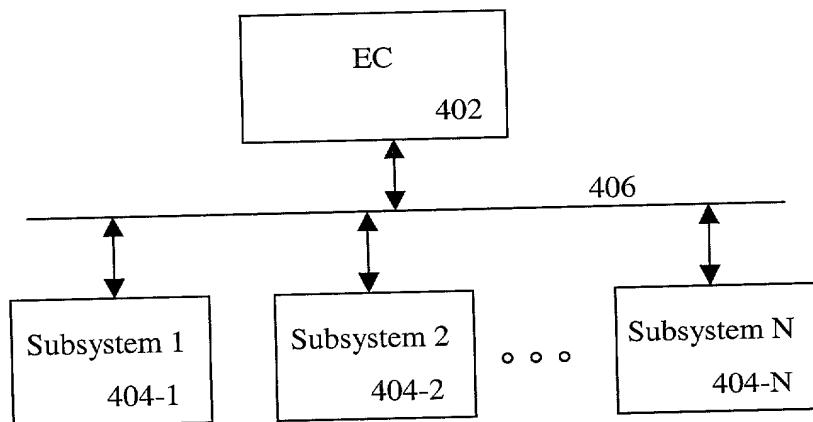


Figure 4

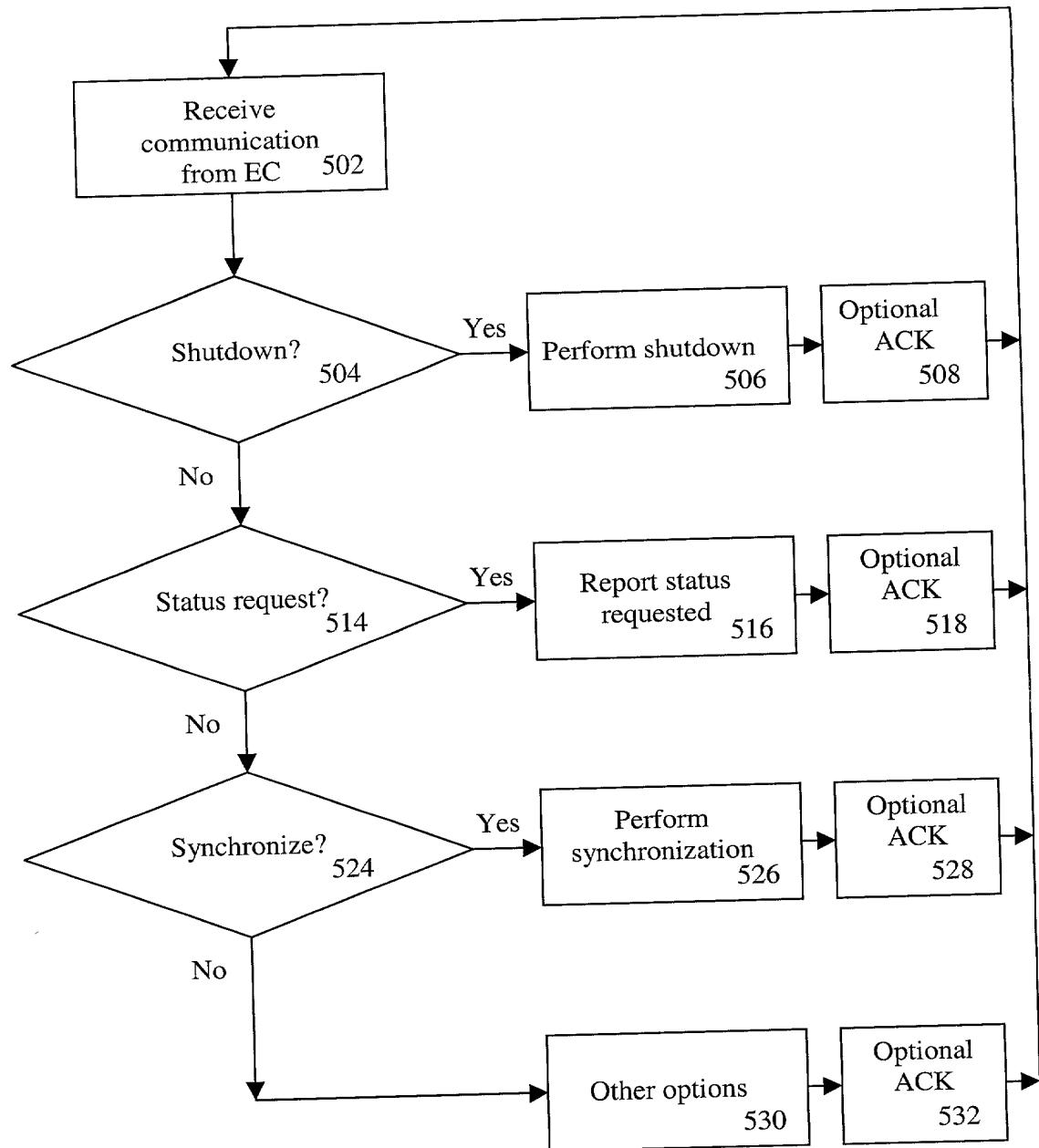


Figure 5

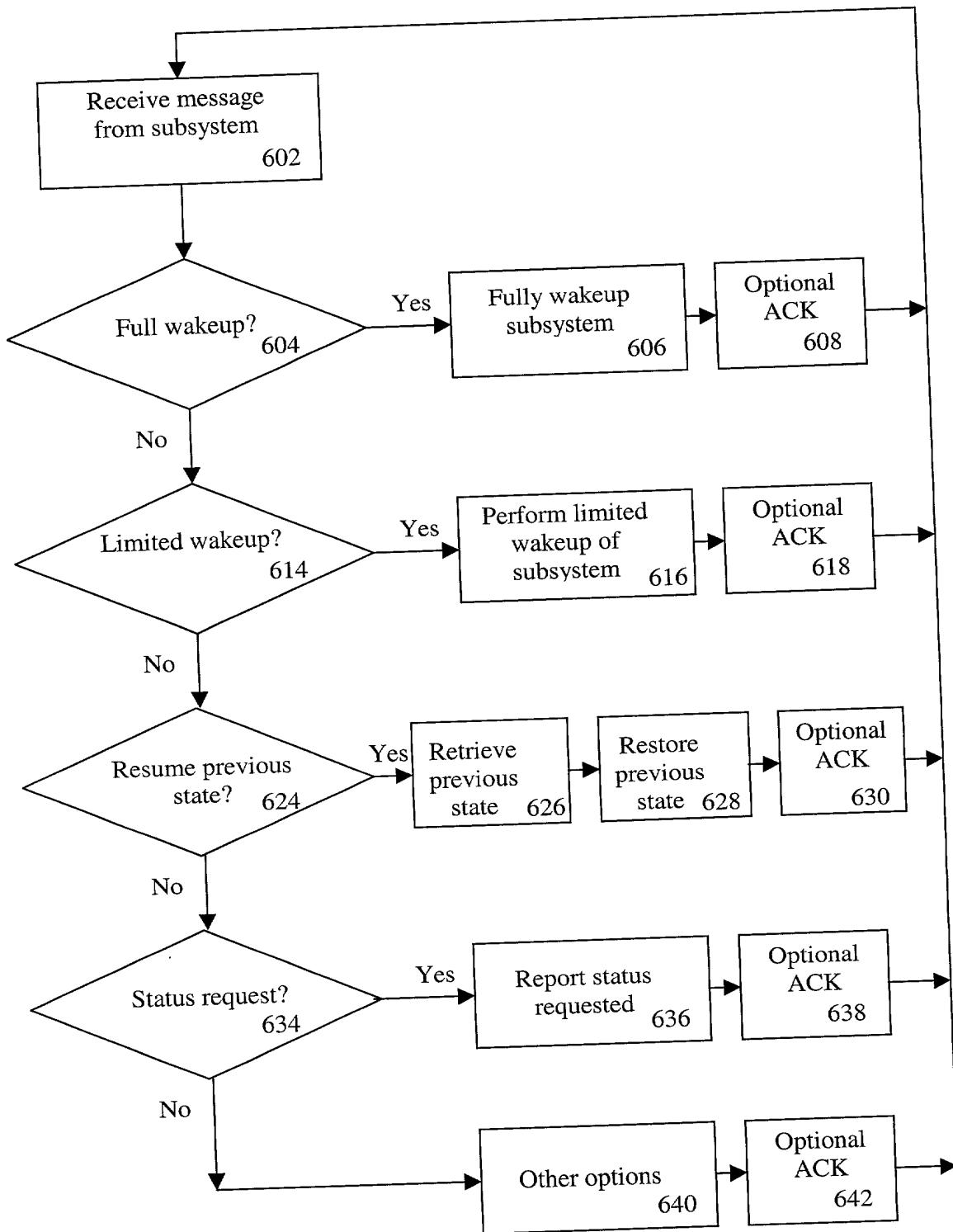


Figure 6

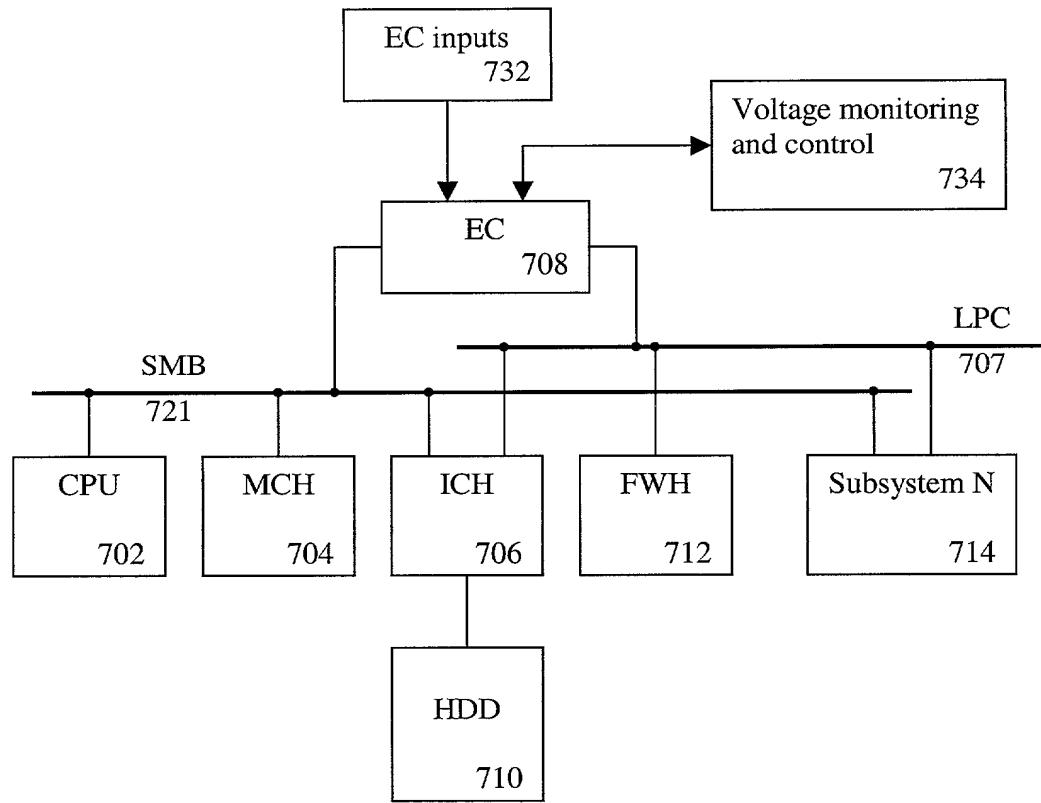


Figure 7

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION  
(FOR **INTEL CORPORATION** PATENT APPLICATIONS)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Method and Apparatus for Facilitating Power State Control and Awareness of an Autonomous Subsystem in a Computer Based System

the specification of which

x is attached hereto.  
— was filed on (MM/DD/YYYY) \_\_\_\_\_ as  
United States Application Number \_\_\_\_\_  
or PCT International Application Number \_\_\_\_\_  
and was amended on (MM/DD/YYYY) \_\_\_\_\_  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

<u>Prior Foreign Application(s)</u>			<u>Priority Claimed</u>
-------------------------------------	--	--	-----------------------------

(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

Application Number	(Filing Date – MM/DD/YYYY)
Application Number	(Filing Date – MM/DD/YYYY)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Number	(Filing Date – MM/DD/YYYY)	Status -- patented, pending, abandoned
Application Number	(Filing Date – MM/DD/YYYY)	Status -- patented, pending, abandoned

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to John P. Ward, BLAKELY, SOKOLOFF, TAYLOR &  
(Name of Attorney or Agent)  
ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct  
telephone calls to John P. Ward, (408) 720-8300.  
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Full Name of Third/Joint Inventor Paul Zurcher

Inventor's Signature \_\_\_\_\_ Date \_\_\_\_\_

Residence \_\_\_\_\_ Citizenship \_\_\_\_\_  
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\_\_\_\_\_

APPENDIX A

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## APPENDIX B

### Title 37, Code of Federal Regulations, Section 1.56 Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.